Chesapeake Marshlands National Wildlife Refuge Complex Third Annual Science Meeting March 8, 2006

Barren Island Restoration through Partnerships and Community Involvement

Poster Presentation

Laura Bankey
410-659-4207
lbankey@aqua.org
Rachel Cliché
Dixie Birch

The islands of the Chesapeake Bay have been rapidly disappearing over the past century and a half. These islands, though small in area, support a number of species and make a unique ecosystem component of the nation's largest estuary. Although similar vegetative communities may occur on the mainland, isolation, relative lack of human disturbance, and fewer predators make islands more desirable as nesting sites for colonial waterbirds and some endangered species. In the past, areas around these islands have supported extensive beds of submerged aquatic vegetation. Erosion, ship wakes, land subsidence and sea level rise are causing these valuable island habitats to disappear.

Barren Island, located near the town of Cambridge and twelve miles south of the Choptank River in the Chesapeake Bay, is part of the Chesapeake Island Refuges of the National Wildlife Refuge System. This group of refuges was established as a waterfowl sanctuary for birds migrating along the critical Atlantic Flyway. The included islands form an 80-mile archipelago through the middle portion of the Chesapeake Bay.

The US Fish and Wildlife Service and the Friends of Blackwater are working with the National Aquarium in Baltimore, the Army Corps of Engineers, and a number of additional partners to create additional salt-marsh habitat on Barren Island. The goals include wetland creation, beneficial use of dredge material and community-based restoration.

BALD EAGLES IN THE CHESAPEAKE BAY AREA

Poster Presentation
Dixie Birch
410-228-2692 ext. 118
Dixie_Birch@fws.gov
Samuel Sturdivant
Michael MacKinnon

The Bald Eagle (*Haliaeetus leucocephalus*) has been America's National Symbol since 1782. In 1940, noting that our national bird was "threatened with extinction," Congress passed the Bald Eagle Protection Act. In 1967, Bald Eagles were declared endangered under the Endangered Species Preservation Act (precursor to the Endangered Species Act of 1973) in all areas south of the 40th parallel. Causes of population declines included: habitat loss, illegal shooting, cutting of nest trees, and use of pesticides such as DDT. Adult Bald Eagles are 3 feet tall from head to tail, have a wingspan over 6 feet, and can weigh 8-15 pounds. Adult Bald Eagles have the distinctive white head and tail, while immatures lack the white head and tail and have dark brown plumage mottled with white until they are 4-5 years old. Bald Eagles primarily eat fish, but will also eat waterfowl, small mammals, snakes, turtles, carrion, and will often steal fish from ospreys and other eagles. Bald Eagles mate for life, and breed between January and March. On July 12, 1995 the U.S. Fish and Wildlife Service re-classified the Bald Eagle from endangered to threatened, and is currently under consideration for complete delisting from the Endangered Species Act. Historically, the Chesapeake Bay Watershed hosted between 1,000 and 3,000 Bald Eagle breeding pairs. Through a combination of the banning of DDT in 1972, habitat protection, and rigorous law enforcement, the Chesapeake Bay Watershed once again has one of the highest concentrations of Bald Eagles in the lower 48 states. Each January since 1979, the Midwinter Bald Eagle Survey has been conducted throughout the United States along standard, non-overlapping survey routes. Objectives of the survey are to establish an index of the total number of wintering Bald Eagles in the lower 48 states. Surveys are conducted during the first 2 weeks of January each year, usually on 1 of 2 target days. Staff and volunteers at the Blackwater National Wildlife Refuge in Maryland have been conducting the Midwinter Bald Eagle Survey since 1979. A morning non-roost count is conducted for 30 minutes, and an evening roost count is conducted for 90 minutes until dark. Since 1979, there has been a steady increase in the total number of wintering Bald Eagles at the refuge. In January 2006, staff and volunteers recorded a total of 127 Bald Eagles during the morning non-roost count. The refuge continues to be a haven for Bald Eagles because of protected habitat and its location on the Blackwater River.

Development Impacts to the Little Blackwater River Watershed

Poster Presentation
Dixie Birch
410-228-2692 ext. 118
Dixie_Birch@fws.gov
Glenn Carowan
Bill Giese
John Gill
Rebekah Packett

The human population in the watershed of the Little Blackwater River is expected to double within the next 10 years. Residential development of 6,400 housing units and a golf course are currently planned, and construction has begun on lands within the drainage area of the Little Blackwater River near Cambridge, Maryland. Currently, the watershed drainage includes parts of the City of Cambridge and approximately 27,748 acres of agricultural lands and woodlands. The Little Blackwater River flows into Blackwater National Wildlife Refuge and is one of two primary fresh water sources for this ecologically important area. Relatively little if any information currently exists on the natural resources of the Little Blackwater River. Water quality and sedimentation problems upstream of the Blackwater National Wildlife Refuge have the potential to affect fish and wildlife resources within the refuge. The U. S. Fish and Wildlife Service is currently working with the State of Maryland, the Chesapeake Bay Foundation, local government officials, and other natural resource organizations to develop and implement an initial baseline assessment, and an annual monitoring program of the natural resources of the Little Blackwater River. The baseline assessment will include data collection on water quality, water quantity, fisheries resources, wildlife resources, and invertebrate communities.

Blackwater Wetland Restoration

Poster Presentation
Dixie Birch
410-228-2692 x 118
Dixie_Birch@fws.gov
Glenn Carowan
Bill Giese
John Gill
Rebekah Packett

Since Blackwater National Wildlife Refuge was established in 1933, it has lost over 8,000 acres of marsh habitats. Several factors have contributed to this loss, including sea level rise, saltwater intrusion, erosion, subsidence, and herbivory by nutria and resident Canada geese. Each year the Maryland Port Administration must dispose of 3 to 4 million cubic yards of dredge material from the approach channels to the Port of Baltimore to keep the channels open. The U. S. Army Corps of Engineer's draft-tiered environmental impact statement lists three options for the placement of clean dredge material. Of these three options, restoring wetlands in Dorchester County, Maryland has the highest environmental benefits and the highest cost. In 2003, the U. S. Fish and Wildlife Service, U. S. Army Corps of Engineers, National Aquarium in Baltimore, and hundreds of volunteers restored 15 acres of wetlands using on-site dredge material at Blackwater National Wildlife Refuge. This demonstration project clearly shows the benefits of restoring wetlands using dredge material. For fiscal year 2006, Congress appropriated $247,000 to begin planning the restoration of wetlands in Dorchester County, Maryland. Currently, we are working with the U. S. Army Corps of Engineers, Maryland Port Administration, University of Maryland, and other partners to restore up to 20,000 acres of wetlands in Dorchester County. In spring 2006, these partners will convene for an international wetlands restoration conference to plan for the restoration of wetlands in Dorchester County.

Predicting the persistence of coastal wetlands to global change effects

D.R. Cahoon, U. S. Geological Survey
301-497-5523
don_cahoon@usgs.gov
G.R. Guntenspergen

Global average eustatic sea level is projected to rise under all emission scenarios used by the Intergovernmental Panel on Climate Change (IPCC). These sea level rise models have been used in combination with coastal elevation data to estimate that a 1 meter rise in sea level could reduce coastal wetlands in the United States by 26 to 66 percent. These low-lying lands provide important habitat for plant and animal species and over US $12 trillion in ecosystem services world-wide. Lidar imagery or detailed elevation surveys have historically been combined with projected rates of sea level rise to assess the vulnerability of coastal wetlands. This approach has not included the potential for coastal wetlands to respond to increases in sea-level rise. We used new technology to understand the linkages and feedback effects that control habitat stability of coastal wetlands, and the specific biological and physical processes that determine how wetland surface elevations respond to changes in relative sea level. We illustrate this approach with work from a site in the Mid-Atlantic (Blackwater NWR) and provide a research strategy which is being used to develop a predictive capacity to forecast future responses of coastal wetlands to changes in external forcing functions (i.e. sea level rise, nutrients, CO2).

Invasive Species Management throughout the Chesapeake Marshlands National Wildlife Refuge Complex

Poster Presentation

Rachel Cliché
410-639-2108 x 222
Rachel_Cliche@fws.gov

Invasive species are threatening the biodiversity of unique and critical habitats, impacting native species throughout the refuges within the Chesapeake Marshlands National Wildlife Refuge Complex (Complex or CMNWRC). The diversity, the number of acres, and the distribution of these invasive species are a challenge, and the Complex has made invasive species management a priority. In March 2005, we held the First Annual Invasive Species Meeting where experts from 10 federal, state, and private agencies convened to focus on management of five invasive species: common reed (*Phragmites australis*), Japanese stilt grass (*Microstegium vimineum),* Johnson grass (*Sorghum halepense*) , Canada thistle *(Cirsium arvense)* and mile-a-minute(*Polygonum perfoliatum*). In July 2005, we held the Volunteer Invasive Mapping Project Workshop that involved the training of Refuge Friends and volunteers to gather invasive species distribution data using a GPS and special software. Approximately, 20 Refuge Friends and volunteers have been trained with dedicated individuals mapping 60 acres of invasive species. We have participated, and will continue to participate, in the US Fish and Wildlife Service regional and multi-regional invasive species management and monitoring projects. These projects involve mechanical and chemical treatment of multi-flora rose (*Rosa multiflora*), garlic mustard (*Alliaria petiolata*), Japanese stilt-grass and *Phragmites*. The Complex, with the help of USFWS staff, Refuge Friends and volunteers, school groups, interns and two County Weed Control agencies, treated approximately, 15 acres of multi-flora rose, 10 acres of garlic mustard, and 300 acres of *Phragmites*. Permanent photo monitoring points were established for each species to determine effectiveness of treatment. Mile-a-minute (*Polygonum perfoliatum*) was discovered on Eastern Neck National Wildlife Refuge (ENNWR) in the early 1990's. This invasive has been actively managed since 2000 with a direct application of Glyphosate during the growing season. Despite these management efforts, mile-a-minute has spread rapidly throughout the refuge. To effectively manage this aggressive weed, other management efforts will need to be implemented. *Rhinoncomimus latipes* beetles, a bio-control agent for mile-a-minute, will be released in 2006 on a portion of the refuge as an experimental management tool. The Complex is working with the University of Delaware on the release and monitoring of this biological control agent. This year will also be focused on writing the CMNWRC Integrated Pest Management Plan (IPM) that will detail specific management strategies for consecutive years. We will also host the Second Annual Invasive Species Meeting in the fall of 2006 to develop and maintain collaborations with partners, and generate new initiatives for the Complex invasive species management program.

Management of the Chesapeake Island Refuges

Poster Presentation
Rachel Cliché
410-639-2108 x 222
Rachel_Cliche@fws.gov

The Chesapeake Island Refuges consist of Susquehanna National Wildlife Refuge (Susquehanna NWR), Eastern Neck National Wildlife Refuge (Eastern Neck NWR) and Martin National Wildlife Refuge (Martin NWR), and its Divisions: Barren Island, Watts Island, Bishops Head, Spring Island and Garrett Island. These island refuges comprise approximately, 7,445 acres of unique ecosystems that span from the head of the Susquehanna River to just beyond the Maryland and Virginia state line in the Chesapeake Bay. Susquehanna NWR was one of the first island units, protected by President Franklin D. Roosevelt in June 1942. This island, and subsequent island refuges, was established to provide critical nesting and wintering habitat for migratory birds, specifically waterfowl. These refuges also support threatened and endangered species such as the bald eagle, peregrine falcon, tiger beetle, osprey and diamondback terrapin. Management of the Chesapeake Island Refuges is not only critical for the resources they support, but for the Chesapeake Bay, the largest estuary in North America, as a whole. These islands shelter the mainland from erosion and turbidity caused by wave energy, and protects the most expansive submerged aquatic vegetation beds in the Bay. The islands are considered to be locally important as black duck production areas. Black ducks are banded every winter to determine productivity. More quantitative data is needed, however, to determine nesting habitat use and predator occurrence on these islands. Staff and funding has been a limiting factor in obtaining this data. The islands also support one of the largest wading bird rookeries in Maryland. Erosion of existing nest sites, limited upland topography for new sites and common reed (*Phragmites australis*) colonization in suitable nesting areas are threatening the stability of these rookeries. *Phragmites* will be chemically managed in 2006. Additional tree and shrub hammocks will be assessed for nesting sites, and erosion control of existing hammocks will be prioritized. Phragmites is not the only invasive species threatening island habitats. Invasive species management is a priority for the island refuges. Numerous management and monitoring projects were initiated in 2005, and will continue through 2006. Additional projects are scheduled this year with focus on the establishment of an Integrated Pest Management Plan. Erosion, ship wakes, land subsidence, and sea level rise are causing island habitats to disappear. The US Fish and Wildlife Service, the National Aquarium in Baltimore and various other partners have restored approximately 24.5 acres on Barren Island, and approximately, 15 acres on Eastern Neck NWR. Wetland restoration efforts will continue in 2006. Hunting, environmental education, wildlife photography, wildlife observation, fishing and interpretation can be experienced at only a few of the island refuges. Plans are underway to develop and implement more opportunities for visitors to experience the unique and diverse habitats and species of the Chesapeake Island Refuges. Protection of island resources is a challenge, and additional staff are needed for law enforcement activities. Illegal waterfowl hunting, trespassing, maintaining archeological integrity and public safety are enforcement issues that need to be addressed.

Maryland-DC's Important Bird Areas Program the search for sites continues

Poster Presentation

David R. Curson
410-558-2473
dcurson@audubon.org
Lynn Davidson

The Important Bird Areas (IBA) Program is an international initiative to protect birds and their habitat. Important Bird Areas, sites essential for one or more species of bird, are identified using science-based criteria that focus on three categories of vulnerable birds: species at risk, habitat specialists, and congregatory species. Conservation goals are achieved at IBAs via partnerships with private or public landowners and land managers. In Maryland and DC 14 IBAs have so far been publicly recognized. We are using a combination of science and public outreach to identify many of the remaining sites. First, analyses of breeding bird atlas data identify regions of high species richness of habitat specialists. IBAs are identified within these regions using information from birdwatchers and biologists. Blackwater National Wildlife Refuge is an Important Bird Area.

Cultural eutrophication in the Choptank and Patuxent estuaries of Chesapeake Bay

T.R. Fisher
410-221-8432
fisher@hpl.umces.edu
J.D. Hagy III
W.R. Boynton
M.R. Williams

The Choptank and Patuxent tributaries of Chesapeake Bay have become eutrophic over the last 50-100 years. Systematic monitoring of nutrient inputs began in -1970, and there have been 2-5 fold increases in nitrogen (N) and phosphorus (P) inputs during 1970-2004 due to sewage discharges, fertilizer applications, atmospheric deposition, and changes in land use. Hydrochemical modeling and land-use yield coefficients suggest that current input rates are 4-20 times higher for N and P than under forested conditions existing 350 yr ago. Sewage is a major cause of increased nutrients in the Patuxent; agricultural inputs dominate in the Choptank. These loading increases have caused three major water-quality problems: (1) increased nutrients, phytoplankton, and turbidity; (2) decreased submerged grasses due to higher turbidity and epiphyton shading; and (3) bottom-water hypoxia due to respiration of excess organic matter. Oxygen in the Patuxent is consistently <3 mg L-1 in bottom waters in summer, whereas oxygen in Choptank bottom waters has been decreasing for the last 20 yr and is now approaching 3 mg L-1 in wet years. The low N:P of sewage inputs to the Patuxent results in an N-limited, P-saturated system, whereas the Choptank is primarily limited by N, but with P limitation of phytoplankton during spring river flows. Insufficient action has been taken to improve the water and habitat quality of the estuaries, although reduced eutrophication in dry years suggests that both estuaries will respond to significant decreases in nutrients.

Comparison of Fixed Route and Multiple Fixed Point Waterfowl Surveys at Blackwater National Wildlife Refuge

Sean Flint
410-228-2692 ext.114
sean_flint@fws.gov
Dixie Birch

Historically Blackwater NWR conducted monthly aerial waterfowl surveys during the peak migration and wintering waterfowl seasons. These aerial surveys effectively canvassed the entire Refuge in a relatively minimal amount of time. Unfortunately, funding for aerial flights has been discontinued. In addition to aerial surveys, weekly ground waterfowl surveys have been conducted in and around the managed wetlands (moist soil units or waterfowl impoundments) since their establishment. However, ground waterfowl surveys at Blackwater NWR are limited to areas of the Refuge accessible by motor vehicle, and require large blocks of time to conduct. To canvas an area representative of that surveyed by aerial flights, and to do so in a timely manner, a multiple observer waterfowl survey was developed and utilized beginning in November of 2004. Specifically this multiple observer waterfowl survey was developed to inventory the significant number of geese which were suspected to exit roost sites within the Refuge at sunrise to utilize foraging locations surrounding the Refuge during day light hours. The average time required to conduct one ground waterfowl survey is about 7 personnel hours, as opposed to the 14 personnel hours required to conduct one multiple observer waterfowl survey. The results from the multiple observer and ground waterfowl surveys will be compared to help determine the effectiveness of the 2 monitoring approaches.

Long-term Fire Research at Blackwater NWR and Fishing Bay WMA

Poster Presentation
Sean Flint
410-228-2692 ext. 114
Sean_Flint@fws.gov
Conception Flores
Cheryl Leonard
Dixie Birch
Marijo Bogue

Historically, fire has been used in marsh areas to facilitate the trapping of fur bearing animals, to reduce the risk of loss of human life and property due to wildfires, and to stimulate the growth of vegetation beneficial to waterfowl and other wildlife. In 1998, a fire evaluation study was initiated on Blackwater National Wildlife Refuge (NWR) and Fishing Bay Wildlife Management Area (WMA) to compare the vegetative response of 2 fire rotations and fire exclusion at 6 tidal marsh areas. The 6 marsh areas were divided into 2 treatment sites (annual burn and 3-year burn) and 2 control sites (no burn). To provide an equal basis for comparisons, all sites (N=24) were initially burned in 1998. Prescribed burns were conducted on the annual burn treatment areas from January-March 1998-2002. A macro-analysis was conducted of the total biomass, live biomass, litter, and stem density data for all species. Species-specific analyses was also conducted for: *Distichlis spicata*, *Juncus roemerianus*, *Schoenoplectus americanus*, *Spartina alterniflora*, and *Spartina patens*. As a result there was no differences in total biomass (biomass including litter) among the treatment and control sites ($P=0.7179$). It was discovered that there is a significantly greater total biomass in 1999 than the other 3 years ($P<0.0001$). Fire had a positive effect (increase) on biomass, and stem density for *Distichlis spicata*, *Spartina alterniflora*, and *Spartina patens.* Fire also increased *Spartina patens* stem densities. Based on findings, it is recommend that prescribed burns be conducted approximately every 1 to 2 years if managers want to increase live biomass and stem densities.

Blackwater River Fisheries and Watershed Restoration Monitoring Project

John Gill
410-573-4511
John_Gill@fws.gov
Michael MacKinnon

The headwaters of the Blackwater River, part of the Blackwater National Wildlife Refuge, was historically freshwater; supporting spawning habitat for migratory fish and characterized by vast expanses of emergent threesquare (*Schoenoplectus americanus)* wetlands. Stewarts Canal, dug in the 1800's, intermittently connected the saltwaters of the Little Choptank River via Parsons Creek to these headwaters. In more recent times, Sea-level rise, land subsidence, and herbivory by the introduced nutria has exacerbated the connection, hydrologically changing former headwater reaches into a regularly tidal saltwater regime. The present average salinities of 12-18 ppt has eliminated anadromous fish spawning habitat. This has also resulted in the conversion of hundreds of acres of fresh and brackish water threesquare marsh into cordgrass marsh (*Spartina* sp.), saline open water and mud flat, with resulting habitat value changes throughout the watershed. Blackwater Refuge, working with a host of partners, intends to repair the breach associated with Stewarts Canal by constructing a saltwater barricade, thus returning the watershed to an ecological continuum comprised of freshwater headwaters, tidal freshwater associated wetlands, and brackish water tidal wetlands in the lower portion of the river. Fisheries monitoring has been undertaken to evaluate barricade success relative to providing requisite freshwater for anadromous fish spawning, and to document changes to the preconstruction fish community. Because saltwater has been a feature of the Blackwater headwaters for some time, anadromous fish species may no longer be imprinted to spawn in this section of the river. Monitoring will determine if anadromous species are spawning in the restored river reach, or if it will be necessary to implement a hatchery reintroduction of blueback herring (*Alosa aestivalis*), the targeted restoration species.

Watershed Restoration of the Blackwater and Little Blackwater Rivers

Poster Presentation
John Gill
410-573-4511
John_Gill@fws.gov
Samuel Sturdivant, Dixie Birch, Bill Giese, Rebekah Packett, Michael MacKinnon

The Dwarf Wedge Mussel, *Alasmidonta heterodon*, was historically found at 70 locations in the United States from New Brunswick to North Carolina. Due largely to habitat degradation, *A. heterodon* is now known only in 10 locations, 3 of which are in Maryland. We sampled 3 tributaries of the Little Blackwater River to determine if *A. heterodon* was present during winter 2005. Two of the sampling sites were predominantly sand, mixed with small amounts of gravel, while the third site contained mainly clay with small amounts of gravel. All sites contained detritus in the sediment. Using a round point shovel, sieve, and a bait scraper, the sites were randomly sampled for the presence of *A. heterodon*. No evidence of *A. heterodon* was found in the tributaries we surveyed. Further sampling is necessary to better characterize the benthic habitats of the Little Blackwater River drainage. Historically, there was a natural divide at Stewarts Canal, which is connected between the Little Choptank River and the headwaters of the Blackwater River. Over the years the Little Choptank River and Blackwater River watersheds have merged, causing saltwater to intrude from the Little Choptank River into the freshwater Blackwater River. This has resulted in the conversion of hundreds of acres of historically freshwater marsh into saline open water and mudflats. Habitat for spawning migratory fish, as well as other fish and wildlife associated with freshwater marshes have been impaired. Blackwater National Wildlife Refuge plans to repair the breach associated with Stewarts Canal by constructing a hydrologic barricade, thus returning the watershed to historic conditions. Information will be collected on fisheries resources before and after barricade construction using fyke nets, minnow traps, and eel traps. Water quality parameters will also be recorded. The purpose of the study is to determine if targeted species will naturally re-colonize restored habitats, or whether a hatchery fish re-introduction is required. The Little Blackwater River watershed includes parts of the City of Cambridge and approximately 27,748 acres of agricultural lands and woodlands. Residential development of 6,400 housing units and a golf course are currently planned, and construction has begun on lands within the watershed. The U.S. Fish and Wildlife Service is currently working with the State of Maryland, University of Maryland – Eastern Shore, Chesapeake Bay Foundation, local government officials, and other natural resource organizations to develop and implement an initial baseline assessment, and an annual monitoring program of the natural resources of the Little Blackwater River. The baseline assessment will include data collection on water quality and quantity, fisheries resources, wildlife resources, and invertebrate communities.

USGS Research to Assist Nutria Eradication in Maryland: Detection and Monitoring a Major Need

Poster Presentation

Mike Haramis
301-497-5624
Michael_Haramis@usgs.gov
Allan O'Connell
Steve Kendrot

In support of interagency initiatives developed cooperatively with the National Invasive Species Council (NISC), the USGS Invasive Species Program is supporting new research to assist with nutria eradication and marsh restoration in the Chesapeake Bay region. This new research will benefit directly the nutria eradication effort managed by the US Fish and Wildlife Service, the Maryland Department of Natural Resources and their partners, and being carried out by the US Department of Agriculture Division of Wildlife Services (APHIS). The new research will build on work first started in 1997 to investigate the role of nutria in the extensive loss of emergent marsh at the Blackwater National Wildlife Refuge in Dorchester County, Maryland. Particular emphasis will be placed on developing efficient remote sensing methods to monitor the presence of nutria and to develop approaches to detect nutria at low densities following systematic removal by trapping. Our goal is to provide managers with science-based monitoring methods to assess temporal and spatial changes in nutria densities and in so doing facilitate nutria eradication efforts in the coastal environment. Over 6 square miles of emergent marsh have been lost to open water on the Refuge since 1938 and much of remaining marsh has incurred significant damage and will likely be lost in the near future. Foraging activity and other surface damage by nutria has been determined to be a major contributor to marsh loss.

Use of a Traditional Harvest Method to Sample Diamondback Terrapins in Winter in Chesapeake Bay

Poster Presentation
Mike Haramis
301-497-5624
Michael_Haramis@usgs.gov
Paula Henry
Dan Day
Dwight Marshall

Harvest of diamondback terrapins (*Malaclemys terrapin terrapin*) in Chesapeake Bay historically took place in the winter months using dredges of various configurations. We worked with Dwight Marshall, an experienced terrapin harvester from Smith Island to document these methods first hand, to assess the effects of commercial harvest on local populations, and potentially adapt the methods for scientific study. In the winters of 2003 through 2005, we used a modified crab scrape to dredge 1,220 terrapins at 7 hibernacula, 6 of which were located in the Tangier Sound area. The scrape was framed from cold-rolled steel stock, was 1.7m wide, and trailed and 8-cm mesh knotted-nylon bag to retain terrapins. The scraping bar was equipped with 30 15-cm long downward facing teeth to help remove terrapins from soft bottom sediments. Hibernacula were located in semi-protected estuarine bays normally within 300 m from nearby marsh. These sites were characterized by water depths from 2 to 4 m and bottoms of moderately soft mud. These conditions provided for good tidal circulation, even under ice cover, while at the same time protecting against dewatering at extreme low storm tides. The cold winters of 2003 through 2005 (<7º C February water temperatures) produced well populated hibernacula of primarily adult terrapins. The dredge did not injure terrapins and proved to be an efficient capture method capable of landing 200 terrapins/hr at our most highly populated site. We found terrapins abundant at most sites and site-specific sex ratios to vary widely. Most importantly, our sampling revealed the relative ease of harvest of large numbers of adult females from estuarine bay hibernacula. Removal of large numbers of breeding-age females could have long-term effects on local terrapin populations.

Population Study of the Diamondback Terrapin in the Chesapeake Bay: 2003-2005

Poster Presentation

Paula F. P. Henry
410-497-5728
paula_henry@usgs.gov
Daniel D. Day
Mike Haramis

The USGS Patuxent Wildlife Research Center is conducting an extensive study to address the distribution and population viability of the Northern diamondback terrapin (*Malaclemys terrapin terrapin*) within the Chesapeake Bay. The current status of the Bay's terrapin population is unknown but like many aquatic species within the Bay, terrapins may be adversely affected by factors such as degradation and loss of their critical habitats and continued commercial exploitation. In 2003, a multi year population study was initiated at Martin National Wildlife Refuge which is located on an off-shore island in the lower Bay. The study area is characterized as high quality terrapin nesting and foraging habitat consisting of pristine salt marsh surrounded by extensive sandy beaches and protected shallow coves. In 2003, data were collected at two additional sites, Eastern Neck National Wildlife Refuge in the upper Bay, and in the Patuxent River on the Bay's western shore. During the initial 3 years of this study, year-round trapping efforts yielded greater than 7800 terrapins, including more than 1500 recaptures. Demography and population estimates based on mark recapture data collected in summer and fall (2003-2005) are presented for the Martin NWR site. Relative occupancy rates within three major categories of habitat type indicate differential use of marsh tidal pools and channels by adult males and females. Ultimately, information on resource needs, population size, structure, and age-class specific survivorship estimates generated by this study will assist resource managers in their efforts to preserve diamondback terrapin populations and their habitats in the Chesapeake Bay.

Invasive Herbivory: A Case Study of Mute Swans and Submerged Aquatic Vegetation in Chesapeake Bay

Larry J. Hindman
410-203-3204
lhindman@dnr.state.md.us
Ketan S. Tatu
James T. Anderson
George Seidel

Mute Swans (*Cygnus olor*) are poorly studied despite their potential to impact submerged aquatic vegetation (SAV). We measured vegetation characteristics (i.e., percent cover, shoot density, and canopy height) of SAV beds in controls (unfenced), 2-year exclosures, and 1-year exclosures at 18 sites in the Chesapeake Bay, Maryland, USA to quantify the impact of herbivory by Mute Swans on SAV during 2003 and 2004. Mute Swan herbivory had a substantial adverse impact on percent cover, shoot density, and canopy height of SAV. At the end of the study mean percent cover, shoot density, and canopy height in the controls were lower by 79%, 76%, and 40% respectively as compared to those in 2-year exclosures. During 2004, percent cover, shoot density, and canopy height increased by 26%, 15%, and 22% respectively between early and late seasons of SAV growth in exclosures, but decreased by 36%, 41%, and 18% in the controls. Six of 7 moderate-depth sites (0.76-0.99 m) were predominantly occupied by paired Mute Swans and these sites experienced less (i.e., 32% to 75%) SAV reduction. All (n = 7) shallow water sites (0.50-0.75 m) were predominantly occupied by Mute Swan flocks and percent cover reduction of SAV was as high as 75% to 100% at these sites. Three of the 5 deep water sites (? 1 m) and 1 of 7 moderate-depth sites also were predominantly occupied by Mute Swan flocks, wherein considerable (i.e., 77% to 93%) SAV reduction was recorded. Thus, considering that flocks are more detrimental to SAV as compared to paired Mute Swans, we recommend that emphasis primarily be placed on controlling Mute Swans population in flocks, and secondarily on pairs. Exclosures should be used in SAV restoration projects and to protect existing critical SAV beds.
Key words: Chesapeake Bay; *Cygnus olor*; exclosure study; exotic; invasions; Mute Swan; Ruppia maritima; Submerged Aquatic Vegetation; SAV; widgeon grass.

Hunt Programs at Chesapeake Marshlands NWR Complex

Poster Presentation

Allen Johnston
410-228-2692
Marijo Bogue
Dixie Birch

Blackwater Refuge is part of the Chesapeake Marshlands NWR Complex. One primary objective of a national wildlife refuge is to provide habitat for the conservation and protection of wildlife. The harvest of surplus animals is one tool used to manage wildlife populations. Carefully managed hunts maintain wildlife populations at a level compatible with the environment, provide wholesome recreational opportunities, and permit the use of valuable, renewable resources. The number of White-tailed and Sika deer harvested grew from 22 in 1985 to 191 in 2004. The number of hunters that participate have increased by 75% within the past 20 years.

The Maryland Nutria Project: Development of Nutria Eradication and Marsh Restoration Strategies for Chesapeake Bay Marshlands

Poster Presentation

Stephen Kendrot
410-221-7857
skendrot@usda.gov

Non-native nutria (Myocastor coypus) became established in Dorchester County, Maryland in the 1940's, and populations have since expanded throughout the Delmarva Peninsula, threatening marsh habitats throughout the Chesapeake Bay watershed. Nutria have been linked to the destruction of more than 7,000 acres of marshlands at the Blackwater Unit of the Chesapeake Marshlands National Wildlife Refuge Complex. The Maryland Nutria Project is comprised of a multi-agency partnership of federal state and private organizations including the U.S. Fish and Wildlife Service, USDA Wildlife Services, Maryland Department of Natural Resources, U.S. Geological Survey and Tudor Farms, Inc. In the current phase of the Maryland Nutria Project, an Integrated Wildlife Damage Management (IWDM) framework is being used to achieve a systematic and progressive removal of nutria from Chesapeake Bay coastal marshes. We describe techniques used to eliminate nutria and ongoing research efforts to develop new harvest and monitoring techniques. To date, nutria have been removed from nearly 85,000 acres of marsh habitat at in Dorchester County, MD. Nearly 90% of trapping units remain nutria free as long as 36 months post removal, indicating that nutria eradication from Chesapeake Bay marshlands may be possible. Research on vegetative response conducted by the USGS shows that removal of nutria populations facilitates dramatic recovery of marsh vegetation. We have observed anecdotal evidence that muskrat populations are increasing in response to nutria removal. The next phase of the program includes expanding eradication efforts throughout the Delmarva Peninsula.

Chesapeake Bay Wetland Restoration

Steven Kopecky
410-962-3413
Steven.kopecky@usace.army.mil
Steven Pugh
Chris Spaur

Over the past five years, the U.S. Army Corps of Engineers, Baltimore District, has been working with the State of Maryland and the U.S. Fish and Wildlife Service to develop a strategy to restore tidal wetlands in the Blackwater NWR and Fishing Bay WMA area. To address this large and complex problem, the planning team developed a three phase approach. The phases included: 1) a small 10 – 15 acre demonstration project, 2) a mid-sized 100 – 200 acre project at Blackwater National Wildlife Refuge, and 3) a landscape-scale effort to restore 1,000s of acres in the Blackwater NWR and Fishing Bay WMA area.

The first phase included the construction of a 15 acre demonstration project and was completed in 2003. As a result of programmatic issues and budgetary constraints, the team decided to skip the second phase and focus attention on phase three. Efforts to conduct landscape-scale restoration have received a major boost by being named as a top priority in the Corps' *Baltimore Harbor and Channels Dredged Material Management Plan*. As a result, we are currently ramping up to evaluate the feasibility of large scale marsh restoration through the beneficial use of clean dredged material.

A collaborative science based approach will be employed to develop a recommended plan for the restoration of this internationally recognized wetland system. The study team will use lessons learned from the demonstration project, from other projects in the Chesapeake Bay area, and from select projects around the country as a foundation to build from. To develop our Project Management Plan (PMP), the team is working with the University of Maryland to plan two upcoming events. The first event is a Chesapeake Bay workshop bringing together ecologists, engineers and economists with experience in the Chesapeake Bay and the beneficial use of dredged material to restore marsh ecosystems. The second event is a three day international conference that will bring in top experts from around the world to provide lessons learned and independent technical review of our PMP.

It is anticipated, that bringing together a broad base of experts from academia; Federal, state and local governments; and the private sector, early on in the development of this study, will result in a better project in the long run.

PRESCRIBED FIRE EFFECTS ON DELMARVA FOX SQUIRREL AND AVIAN HABITATS IN MID-ATLANTIC COASTAL PLAIN FORESTS

Poster Presentation

Michael MacKinnon
410-228-2692 ext. 119
mmackinnon@usgs.gov
Dixie Birch
Carol Bocetti
Laura Mitchell
Oliver Pattee

Prescribed fire is being implemented in mid-Atlantic coastal plain forests to reduce hazardous fuel loads. No studies currently exist on the ecological effects of prescribed fire on the endangered Delmarva fox squirrel (*Sciurus niger cinereus*, Fig. 1), a species whose range has contracted to an extremely localized geographic area (Fig. 2). Our objectives are to provide regional forest managers with information on the physical effects of prescribed fire (focusing on fuel loads), and the biological effects, with emphasis on sub-canopy plant community structure, and densities of Delmarva fox squirrels and forest-interior dwelling birds (Fig. 5). We conducted prescribed burns at Chincoteague National Wildlife Refuge in spring 2003 (Fig. 4) and at Blackwater National Wildlife Refuge in fall 2004 (Fig. 6). Our hypotheses are that hazardous fuel reduction fires during the growing season will: (1) significantly reduce hazardous fuels, (2) cause significant mortality in the ground and shrub vegetative layers, (3) enhance Delmarva fox squirrel habitat, and (4) change densities of some forest-interior dwelling birds. Preliminary results indicate changes in the ground and shrub vegetative layers, and an increase in habitat use by some squirrels. After further analyzing our results, we will develop recommendations for reducing fuel loads and managing Delmarva fox squirrel habitat.

Building a Predictive Model of Delmarva Fox Squirrel *(Sciurus niger cinereus)* Occurrence Using Infrared Photomonitors

Charisa Morris
410-573-4550
charisa_morris@fws.gov
Dean F. Stauffer
Mary J. Ratnaswamy

Habitat modeling assists in the management of potentially widespread but poorly known biological resources such as the endangered Delmarva fox squirrel (DFS; *Sciurus niger cinereus*). The ability to predict or identify suitable habitat is a necessary component of this species' recovery, as well as an important consideration when evaluating impacts of residential and commercial development on the Delmarva Peninsula. Using infrared photomonitors, we documented habitat use of Delmarva fox squirrels at 27 of 86 sites in the southern Maryland portion of the Delmarva Peninsula. We used logistic regression and the information theoretic approach to develop and analyze 6 model sets that attempt to predict the probability of Delmarva fox squirrel habitat use as a function of habitat characteristics. Significant ($P < 0.10$) variables included density of trees > 50 cm dbh (x_{used} = 16 stems/ha vs. x_{unused} = 8 stems/ha), distance from agricultural fields (x_{used} = 964 m vs. x_{unused} = 1308 m), shrub stems/ha (x_{used} = 8068 stems vs. x_{unused} = 11119 stems), canopy height (x_{used} = 31 m vs. x_{unused} = 28 m), and percent canopy cover (x_{used} = 82% vs. x_{unused} = 73%). This increased ability to identify habitat variables that are associated with DFS presence should improve attempts at a systematic rangewide survey, and will expedite the Endangered Species Act consultation process by simplifying site screenings.

Carbon sequestration in restored tidal marshes at Blackwater National Wildlife Refuge

Brian A. Needelman
301-405-8227
bneed@umd.edu
Martin C. Rabenhorst
Raymond R. Weil

Methods to reduce atmospheric carbon dioxide concentrations include the reduction of anthropogenic and biological carbon emissions and the sequestration of carbon in terrestrial, oceanic, and geological reservoirs. Natural tidal marshes have among the highest carbon sequestration potential of any terrestrial ecosystem due to high net primary productivity, high organic matter contents, and accretion due sea-level rise. The objective of this project is to quantify and better understand rates of carbon sequestration in restored tidal marshes at Blackwater National Wildlife Refuge. Sequestration rates in restored marshes may be higher than in natural marshes if the ecosystem follows an increasing trend towards natural marsh carbon densities. However, rates may be lower if the restored marshes do not have the same net primary productivity of natural marshes.

We will be collecting samples from three marsh cells over an eight-year period: a cell created from coarse-textured sediments in 2003, a cell created from organic sediments in 1983, and a natural marsh cell. Within each cell, sediment elevation tables (SETs) have been installed by Donald Cahoon from the USGS. We will be laying out three transects originating from each SET, giving us nine transects per cell. Four to six sampling points will be established along each transect. At each sampling point, a feldspar marker horizon will be laid down to mark the initial surface of the marsh. Cores will be collected at each point annually. Cores will be divided into horizons and analyzed for bulk density and carbon. Selected cores will also be analyzed for particle size, nutrients, and labile carbon.

This study will allow us to better understand factors controlling carbon sequestration rates in restored tidal marshes and to estimate carbon sequestration rates for the larger proposed Blackwater restoration study. The marshes also serve as demonstration sites for the Midwest Regional Carbon Sequestration Partnership (MRCSP).

Geologic Research at Blackwater National Wildlife Refuge

Wayne L. Newell
703-648-6991
wnewell@usgs.gov
Curt Larsen
Inga Clark
Adam Benthem

Knowledge of the geologic framework and the function of earth surface processes can improve the efficacy of resource management decisions for a changing environment. Four different research objectives are being studied to create a comprehensive geologic framework for the Blackwater NWR. These include (1) defining the Miocene substrate (St. Marys Formation?), (2) mapping Pleistocene estuarine terrace deposits and deep channel fill deposits, (3) interpreting geomorphic features that are artifacts of extensive, long duration frozen ground phenomena, and (4) describing the history of Holocene sea level rise culminating in the present extant of the wetlands. Outcrops are limited. Therefore we study the stratigraphic sequences of Miocene, Pleistocene, and Holocene sediments by acquiring cores and auger hole logs and reinterpreting antecedent well logs and engineering test borings. These subsurface data will locally be supported with shallow subsurface profiling using Ground Penetrating Radar (GPR) and/or shallow seismic tools. The geomorphology is being interpreted from the extant 7 1/2' quadrangles supplemented with a specially generated high resolution LIDAR map that reveals complex surficial features previously anticipated from early aerial photos but indistinguishable on available topographic map bases. Antecedent maps and subsurface data and our growing collection of new cores indicate that the Blackwater NWR is underlain by a middle- to late-Miocene delta with inter-bedded sand, fine sand, and clayey silt that may be more than 100 feet thick. Low terraces of the uplands around Blackwater NWR are capped by thin ancestral Chesapeake Bay bottom deposits that include clayey silt, fine sand, and sand and gravel commonly less than 15 feet thick. The most extensive are generally correlated with the last sea level high stand (Stage 5e) at the last interglacial period (late Sangamon). These deposits are cut by at least two deep ancestral Susquehanna River channels that have been filled by several sea level rise sequences culminating in as much as 50 feet of modern deposits. The surficial deposits the present transition from a glacial to an interglacial climate as dune fields, patterned ground, and broad braided stream channel deposits give way to wetter, warm climate fluvial, paludal, estuarine, and littoral deposits that continue to accumulate as sea level rises. The configuration of this framework suggests that much of the actual Blackwater NWR wetlands are superimposed on the deep ancestral Susquehanna channels; the wetlands may be subject to subsidence from sediment loading and compaction, compounding the effects of continuing Holocene sea level rise. Much of the groundwater discharge at Blackwater NWR is probably derived from the substrate of Miocene deltaic facies. High volume base flow from this source could be a factor in maintaining freshwater wetlands if brackish intrusion from the Bay can be contained.

Responsible Management of the Little Blackwater River Watershed

Rebekah Packett
410-228-2692 ext. 111
Rebekah_Packett@fws.gov
Dixie Birch

The Little Blackwater River flows into Blackwater National Wildlife Refuge. The Little Blackwater River drains a catchment area of approximately 27,748 acres. The land surface is level, with frequent flooding due to poor drainage, low flow gradients, high water tables, and hydric soils. Approximately 6,400 new housing units, a golf course, conference center, and hotel are planned on lands near or adjacent to the Little Blackwater River. The U.S. Fish and Wildlife Service is working with our research partners at the U.S. Geological Survey, Maryland Department of Natural Resources, and the University of Maryland to develop and implement research projects to determine a baseline inventory and assessment of the natural resources of the Little Blackwater River before development. We have recommended to the City of Cambridge and Dorchester County that a 1% impact fee be assessed for the cost of each house built in this drainage. This impact fee would provide funding for the baseline assessment studies estimated to cost $613,076. In addition, we have requested an annual monitoring program estimated to cost $500,000 per year for each year during and after construction. Furthermore, we requested that a responsible party be identified to mitigate for damages if damages are detected during the annual program.

Harmful Algal Blooms and Bird Die-offs in Chesapeake Bay: A Potential Link?

Barnett A. Rattner
301-497-5671
Barnett_rattner@usgs.gov
Glenn H. Olsen, Peter C. McGowan, Betty K. Ackerson, and Moira A. McKernan

Autumnal die-offs, involving hundreds of migratory birds, occurred in Chesapeake Bay in 2001, 2004 and 2005. The most prominent events were at the Poplar Island Complex in proximity to freshwater and brackish water impoundments. These impoundments contained algal blooms and elevated cyanobacteria counts (including *Anabaena sp.,* a microcystin producing genera). Although avian botulism was documented as the cause of death of some individuals, recent evidence suggests that microcystin (MC) may play a role in the initiation of such botulism outbreaks. During these outbreaks, many dead and dying great blue herons (*Ardea herodias*) were observed at or near these impoundments at the Poplar Island Complex. Nearly half (9 of 22) of these individuals collected had detectable quantities of MCs (but not other toxins) in liver tissue, while MCs were not detected in herons collected 50 kilometers southeast at Blackwater NWR. Affected herons presented clinical signs of emaciation, lethargy, inability to fly, firm distended abdomen, anemia, dehydration and diarrhea. Rehabilitation efforts were unsuccessful, and moribund birds were euthanized. Necropsies revealed excessive abdominal deposits of waxy yellow fat (i.e., steatitis, inflammation of the adipose tissue) compared to controls (mean weight of fat $\pm$ standard deviation; 371 $\pm$ 90.6 grams versus 78 $\pm$ 54.7 grams). The gastrointestinal tract of affected birds was nearly empty, containing small amounts of greenish vegetation and insects, in contrast to fish found in herons from the reference site. The most significant hematological changes in affected birds included anemia, depressed plasma cholesterol and potassium, and remarkably low Vitamin E concentration (1.37 $\pm$ 0.53 µg/ml versus 17.32 $\pm$ 5.19 of reference herons). These observations are consistent with historic findings of steatitis in great blue herons from the Chesapeake (Nichols et al. 1986). We hypothesize several potential causes of steatitis in herons, including (i) a dietary shift by herons to fish species that are high in polyunsaturated fats (e.g., herring) ("*Alternate Prey Hypothesis*") (ii) consumption of dead (or possibly dying) rancid fish containing large quantities of oxidized fatty acids ("*Rancid Fish Hypothesis*"), and/or (iii) exposure to algal toxins by ingestion of water with their prey or indirectly by ingesting prey containing microcystins ("*Harmful Algal Bloom Hypothesis*"). In support of this *Harmful Algal Bloom Hypothesis*, elevated cyanobacteria counts (*Anabaena* spp.) were detected in impoundments near the die-offs and microcystins were frequently detected in water samples and in liver tissue of dead and dying great blue herons. Alteration of Vitamin E levels in affected great blue herons is suggestive of depletion of cellular antioxidants (well recognized detoxication response), and possibly one of the independent or inter-related events associated with cellular dysfunction and toxicity evoked by MCs. We hope to more thoroughly investigate the role of MCs and other phycotoxins in recurring waterbird die-offs in Chesapeake Bay through controlled exposure and field investigations.

Elevation of Blackwater NWR

Galen Scott
301-713-3198
galen.scott@noaa.gov

In September 2005, NOAA's National Geodetic Survey lead a height modernization survey to determine high accuracy elevations for bench marks, tide stations, stream gauges and Surface Elevation Tables (SETs) in and around Blackwater NWR. Global Positioning System (GPS) observations were made in cooperation with the Center for Operational Oceanographic Products and Services, US Geological Survey, US Fish and Wildlife Service, Friends of Blackwater, and the National Aquarium in Baltimore. These observations were then adjusted to compute a consistent height reference system to enable the integration of observing systems from several agencies, increasing the value of all of the observations by making them comparable to each other.

NGS activities surrounding this survey included a geodetic control workshop for survey participants, reconnaissance to identify existing GPSable benchmarks, installation of nine deep rod foundations for SETs and six new bench marks near remote water level gages or SETs. The height modernization survey itself included 29 control points that were simultaneously observed with survey-grade GPS receivers for three four-hour sessions over two days.

NGS has processed the GPS observations and completed the "Bluebook" process for the survey. Results of the survey will be published in the NGS database. This presentation will cover the work NGS has done and the implications for collaborating partners at Blackwater. The presentation will also encourage a dialog with participants to discuss positioning requirements of current and future habitat restoration activities.

Monitoring Tidal Stage and Salinity in Parsons Creek and the Blackwater River, Dorchester County, Maryland

Daniel J. Soeder
410-238-4213
dsoeder@usgs.gov

Deterioration of the marsh at Blackwater National Wildlife Refuge has created a breach in the watershed divide between the tidal brackish water of Parsons Creek, and the freshwater ponds at the headwaters of the Blackwater River. The resulting increase of salinity in the upper reaches of the Blackwater River has altered the habitat from fresh to brackish, replacing historical freshwater vegetation with more salt-tolerant plants. The Maryland Department of the Environment (MDE) is constructing a barricade across the upper end of Parsons Creek at its connection to Goose Dam Pond, a fresh/brackish water body at present. The U.S. Geological Survey (USGS) conducted measurements of tidal stage and salinity to investigate saltwater intrusion and document the changes that may result from the barricade installation. Salinity measurements by the USGS at the upper end of Goose Dam Pond showed a salt content as high as 10 parts per thousand (ppt), comparable to the brackish waters of Chesapeake Bay. Instrumentation was emplaced to monitor tidal stage (water-level elevation), and to measure salinity (as temperature/conductivity) at three locations: one below the proposed barricade site, one above it, and the third at a footbridge in the headwaters area of the Blackwater River. Water levels were measured using solid-state, submersible, vented pressure transducers, and salinity was determined with submersible temperature/conductivity probes. The data were manually downloaded from dataloggers every few weeks from March 2005 to mid-October 2005, when the equipment was recovered from the field. Flow through the system is complex. Water levels may have changed with tidal cycles and precipitation events, and at times may have been strongly affected by wind. Diurnal tidal cycles were observed at Parsons Creek, Goose Dam Pond, and at the Blackwater footbridge, although the footbridge water level was often affected by other events. Tidal amplitudes in most cases were quite low: less than 2 feet at Parsons Creek, about a foot at Goose Dam Pond, and approximately a half-foot at the Blackwater footbridge. Out-of-phase tidal cycles at both ends of the waterway, and storage within the system caused flows to behave sometimes in an almost counter-intuitive manner. One visual observation recorded water flowing out of Parsons Creek, while the water level at the mouth of the creek was steadily rising on an incoming tide, the opposite of what was expected. Salinity responses were also complex, and found to change in response to tidal and possibly wind-driven flow. The salinity at the mouth of Parsons Creek normally fluctuated daily on the tidal cycle, but it could also remain high or low for several days at a time. Comparisons with measurements made by the Maryland Department of Natural Resources at Casson Point showed that the salinity in Parsons Creek never exceeded that of Chesapeake Bay, lending confidence to the data. Salinity at the footbridge generally remained around 2 ppt, although there were some instances when it went as high as 5 to 7 ppt for short time periods.

Fish Sampling of the Little Blackwater River

James Stephenson
203-685-3034
ctboyinark@yahoo.com

The human population in the watershed of the Little Blackwater River is expected to double within the next 10 years. The Little Blackwater River flows into Blackwater National Wildlife Refuge and is one of two primary fresh water sources for this ecologically important area. Water quality and sedimentation problems upstream of the refuge have the potential to affect fish and wildlife resources on Blackwater National Wildlife Refuge. The Little Blackwater River and Blackwater National Wildlife Refuge are both integral parts of the Harriett Tubman and Underground Railroad Heritage Areas, which have been identified by Dorchester County, the State of Maryland, and are under review by the National Park Service. No information currently exists on the water quality or fisheries resources of the Little Blackwater River. Historically, the River supported both resident fish (e.g. largemouth bass, crappie) and andramous (migratory) species (e.g. river herring, American shad). In the past, the River has supported a commercially sustainable diversity of species including white perch, American eel, catfish, and a host of forage species. These fish species provide a vital link in the food chain for important raptor species such as the bald eagle and the American osprey. Fishery resources within and surrounding the Refuge are important to the overall health of the Chesapeake Bay. Through a collaborative partnership with the Maryland Fishery Resources Office of the U.S. Fish and Wildlife Service, Blackwater National Wildlife Refuge, and students from Historically Black Colleges and Universities, we will sample water quality and fisheries resources to provide baseline information using hydrolabs, seines, cast nets, elver traps, fish traps, and fyke nets.

The Study of the Tidal Characteristics of Blackwater National Wildlife Refuge

Allison Stolz
301-713-2890 ext. 166
Allison.Stolz@noaa.gov

NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) currently operates four water level gauges near Blackwater Wildlife Refuge (Blackwater). Since fall of 2003, NOAA has been working with partner agencies to understand the tidal characteristics of Blackwater. In Fall 2003, NOAA installed a long-term water level gauge at McCready's Creek while the US Army Corps of Engineers (USACE) was simultaneously operating 5 short-term pressure gauges scattered throughout the refuge. Upon removal of the USACE gauges, their 6-minute data was ingested into the NOAA database so that harmonic analysis and simultaneous comparison could be done between gauges in different parts of the region. The result was a basic understanding of the timing of tidal progression throughout the refuge and of meteorological impacts on water levels. Even though in for a short time, the USACE gauge captured the extreme high water effects of Hurricane Isabel on Blackwater, as well as a meteorologically driven extreme low water event. However, without vertical reference of the USACE pressure gauges, water levels relative to a common vertical reference on each side of Shorters Wharf Road could not be obtained. In Summer 2005, USGS installed three stage gages throughout the western extent of the refuge to study pre-condition water levels before a planned weir was installed in upper Parsons Creek. Since these installations complied with the NOAA protocol of 6-minute water level data, their data will be formatted and ingested into the NOAA database for comparison with the four NOAA tide gauges operating on the Blackwater periphery to enhance the understanding of tidal progression throughout the region, particularly on the western side of the refuge. In Fall 2005, a comprehensive GPS survey was orchestrated by NOAA's National Geodetic Survey to simultaneously occupy 29 different bench mark locations throughout Blackwater that tied in tidal bench marks and surface elevation table marks (SETS) in with the geodetic network. Included in those bench marks were tidal benchmarks at the NOAA gauges at McCready's Creek, Beaverdam Creek, and Cambridge, as well as USGS stage gage locations. Once processed, these geodetic elevations will provide a baseline to better understand relative elevations throughout the basin, to provide more information about stages of tide, effects of roads like Shorters Wharf Road on water levels and circulation, and saltwater intrusion. While the complexity of Blackwater's tidal characteristics cannot be completely understood through observations at just twelve distinct points, tremendous advances have been made. Continued observations will refine a basic understanding to a more complete working knowledge of flow through the refuge. These fundamental observations can be used as baseline elevations that can be integrated with LiDAR topography, new bathymetry, and datum models for development future digital elevation models. Through partnerships and common data standards, a greater understanding of water levels throughout Blackwater has been made possible.

Water Quality of Non-tidal Streams in Dorchester County

Joshua Stone
410-745-5669
Squirrelwrangler@gmail.com

A major problem affecting the Chesapeake Bay (the nation's largest and one of the most productive estuaries) is nutrient and suspended solids pollution. As precipitation flows into and over the ground of agricultural and developed areas, it picks up fertilizers, erodes soil and flows into the Chesapeake Bay. These increased concentrations of nutrients and suspended solids create turbid, nutrient-rich waters that often result in algal blooms in surface waters and low oxygen in bottom waters.

I sampled 10 watersheds in Dorchester County to test the hypothesis that watersheds with less forest and more agriculture and developed land had decreased water quality. Water samples were collected on twenty-one occasions from November 2004 to October 2005 during periods of high runoff following storms and during baseflow (groundwater only). Each sample was analyzed for total suspended solids (TSS); dissolved phosphate (PO_4); pH; particulate phosphorus, carbon, and nitrogen; ammonium; nitrate; and conductivity. ArcGIS 9.1, Digital Orthophoto Quarter Quads (DOQQs), and LIDAR were used to analyze the watersheds of the sampling sites in order to determine the percentages of land cover within them. The nutrient and TSS data showed correlations with land cover in the ten sub-basins and indicated that at least 40% of a watershed needs to be forested and with at least 15% of the watershed consisting of wetlands in order to significantly limit the amounts of TSS and excess PO_4 flushed into the Bay's waters. Any watersheds with less than these natural land cover thresholds exhibited significantly decreased water quality in terms of nutrients and TSS.

Chesapeake Marshlands NWR Complex
Vegetation Mapping Project

Poster Presentation

Roger Stone
410-228-2692 x115
roger_stone@fws.gov

In September of 2004 Chesapeake Marshlands NWR Complex contracted with Woolpert, Inc. of Portsmouth, VA to acquire aerial photography and with James W. Sewell Company of Old Town, ME to produce a vegetation map of the NWR Complex and surrounding lands. The mapped areas include Blackwater NWR and adjacent lands (52,470 acres), Eastern Neck NWR (2,100 acres), seven Chesapeake Bay islands (14,000 acres), and a portion of the Nanticoke River watershed (24,000 acres).

Aerial photography was acquired on two occasions to maximize detection of differences in vegetation of two major classes of vegetation. In May 2005 Nanticoke, Eastern Neck and Blackwater were photographed using color infrared film to capture the forested lands at leaf blush in order to enhance differentiation of canopy species. In August 2005 the entire 92,776 acre project area was photographed with true color film to provide images for the differentiation of marsh species and species groups. Products received include 1:12,000 scale prints and triangulated, DEM processed, and ortho-rectified digital photography for the May and the August flights. The color film was scanned at 14 um with a high resolution scanner to produce a mosaic of orthophotos with a 0.25 meter pixel resolution.

James W. Sewall Company used full stereo coverage aerial photography (false positive film transparencies) supplied by Woolpert to produce vegetation maps. In consultation with NatureServe, the National Vegetation Classification System was used in combination with Ecological Systems which were developed to enhance the usability of the final product. There are three types of interpretation coding for the project: Forests, Non-Forested Wetlands, and Landuse codes (generally anthropogenic or non-vegetated). Forests have a minimum mapping unit area of 1 hectare, while non-forested wetlands and landuse types have a minimum mapping unit area of 0.5 hectares.
LIDAR data, provided by the state of Maryland, were processed by Sewall by extracting the data from text files and creating ArcGIS grids with 2-meter cell size. The resulting grid tiles were merged to produce individual data sets for bare earth and maximum first return. The grid files were processed to produce three grid data sets representing heights.

Delivered products include: printed and geo-referenced digital aerial images in color infrared (Nanticoke, Blackwater, and Eastern Neck) and true color (entire project area); vegetation cover types provided in ArcGIS project format and including vegetation height and bare ground elevations; and International Ecological Classification Standards for Chesapeake Marshlands NWR Complex and Chesapeake Marshes (NatureServe). The total project cost was $309,647 for mapping of 92,776 acres ($3.34/acre).